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BULLETIN

OF THE

TORREY BOTANICAL CLUB

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Vol. 47 No. 7

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JULY, 1920

Illustrations of six species of Riccia, with the original descriptions

CAROLINE C. HAYNES

(WITH PLATES 10–13)

A systematic account of the North American Ricciaceae will soon be published by Dr. Marshall A. Howe in the North American Flora. Among the species of *Riccia* attributed in this work to the United States the following six have not yet been adequately figured, at least from American material: *R. Donnellii*, *R. dictyospora*, *R. Beyrichiana*, *R. arvensis*, *R. hirta* and *R. Curtisii*.* It therefore seems fitting to publish in advance illustrations of these species. The data in regard to distribution and synonymy have been taken, with Dr. Howe's permission, from his manuscript; and for the sake of completeness the original descriptions, which in some cases are difficult of access, are reproduced in full.

1. RICCIA DONNELLII Aust. Bull. Torrey Club 6: 157. 1877

"Dioica maxima; fronds solida esquamosa subglauca superne maxime reticulata subtus concolore, laciniis subsimplicibus pro more discretis planiusculis siccitate canaliculatis costatis margine spinulis (serie singula) breviusculis hyalinis valde incrassatis obtusus patentibus armatis, nervo solidissimo valde incrassato subtus in media fronde terminante apice valde incrassato obtuso subdescendente, sporangiis serie singula in media fronde versus basin sitis, sporis maximis subrotundis nigris valde opacis subtuberculatis; involucris masculinis magnis valde prominentibus

* As indicated later *R. Curtisii* has recently been figured by McAllister, but chiefly as to the morphology of the sporophyte; and *R. Beyrichiana* has doubtless been illustrated by European authors under the name *R. Lescuriana* and possibly under other names.

[The BULLETIN for June (47: 231–278, *pl. 8, 9*) was issued June 23, 1920.]

subbasilaribus.—In a garden at Jacksonville, Florida, Feb., 1877.—*J. Donnell Smith.*"

HABITAT: in gardens and waste places, usually on sand.

DISTRIBUTION: Florida and Texas.

EXSICCATAE: Underw. & Cook, Hep. Amer. *42*.

2. RICCIA DICTYOSPORA M. A. Howe, Bull. Torrey Club **28**: 163. 1901

"Thallus simple or once dichotomous, forming irregularly gregarious patches, finally oblong or elongate-obovate, rarely sublinear, 4–10 mm. × 1–2 mm., reticulate above, light green (when dry) with at length a narrow dark-purple border; median sulcus acute and somewhat pronounced toward the apex; ventral scales entire, purple at maturity, slightly exceeding the thin submembranous ascending thallus-margins; width of transverse sections of the thallus 1.5–3 times their height, the ventral outline rounded-convex or somewhat flattened, air-canals narrow and vertical, special cells densely filled with a yellowish granular substance ('oil-body' cells) usually abundant; primary epidermal cells oval-papilliform, soon collapsing, leaving more or less persistent cup-like vestiges: monoicous; antheridial ostioles not elevated: spores brown, rather translucent, soon exposed by the rupture of the overlying parts, 95–116 μ in maximum diameter, scarcely angled, somewhat flattened, wholly destitute of wing-margins, almost uniformly areolate over entire surface, in optical section appearing densely beset on all sides with short truncate spines or papillae; areolae of the outer face 8–12 μ in width, often less perfect in the middle of the face; areolae of the inner faces so similar to those of the outer as not to be readily distinguished at first sight, yet slightly larger and less regular, with somewhat less elevated boundaries.

"On moist granite rock near Oconee River, Athens, Georgia (alt. 183 m.), Roland M. Harper, June 26, 1900, no. 68a."

HABITAT: moist granite rocks.

DISTRIBUTION: Connecticut and Georgia.

EXSICCATAE: Harper, Georgia Plants *68a*.

3. RICCIA BEYRICHIANA Hampe; Lehm. & Lindenb. in Lehm. Pugill. **7**: 1. 1838

"R. *fronde carnosa oblongo-lineari bifida, supra canaliculata, margine adscendente integerrima, subtus nigro-purpurascente, apicem versus incrassata.*

"In America boreali inter Jefferson et Gainsville legit C. Beyrich, Specimina communicavit cl. Hampe.

"Frondes caespitosae, radiculis multis longis hyalinis terrae adhaerentes, 2–4 lineares, e basi angusta lineari sensim dilatatae, rarius simplices, plerumque ad tertiam partem et ultra bifidae; lobi paullo divergentes, obtusiusculi, nonnunquam iterum emarginato-bifidi. Tota frons est carnosa, apicem versus subtus magis tumida, supra canali medio angusto instructa, viridis, margine subadscendente, sphacelata, subtus membrana nigro-purpurascente vestita, integerrima. Sub epidermide hyalina tenera e cellulis hexaedris conflata adest stratum viride satis spissum. Contextus cellulosus internus est laxior, cellulis irregularibus.

Obs. Proxime accedit ad *R. hortorum* [an African species], quae distinguitur statura multo majore, fronde latiore margine undulato-crenata subtus minus tumida. *Riccia tumida* [a synonym of *R. Michelii* Raddi, a European species] differt a nostra fronde minus divisa ciliata basi planiuscula."

TYPE LOCALITY: between Jefferson and Gainesville, Georgia.

DISTRIBUTION: Massachusetts to Florida, Texas, California, and Alberta; also in Europe.

EXSICCATAE: Aust. Hep. Bor.-Am. *143* (as *R. Lescuriana*).

The original description of *Riccia Lescuriana* Aust.,* which is now considered a synonym of *R. Beyrichiana*, is as follows:

"RICCIA LESCURIANA, Aust. MSS., 1863.

"R. fronde solida subciliata orbiculata stellatim vel subcruciatim divisa incrassata, supra punctato-reticulata glauco vel cineraceo-viridi epidermide macula purpurea supra fructum notata, subtus nuda concolore vel demum purpurascente; laciniis bilobis vel di-trichotomis obcordatis lineari-cuneatisve (2–5 lin. longis, 1–2 lin. latis) leniter concavo-canaliculatis, apice emarginatis brevi sulcatis, margine hirsuto-ciliatis incrassatis obtusis subadscendentibus ad apicem subinvolutis; ciliis creberrimis brevibus albidis obtusis in statu juniori subobsoletis; fructibus sparsis non seriatis subbasilaribus, sporis fusco-atris angularibus reticulatis: gemmis? numerosis ellipticis aterrimis in frondis facie superiori versus loborum apicem positis quam sporis triplo minoribus.—*Hep. Bor. Amer. Exsic. ined.*, *N.* 143.

* Proc. Acad. Nat. Sci. Philad. **1869**: 232. 1869.

"Var. α, cruciata. Fronde cruciatim parce divisa, laciniis ciliisque brevissimis.

"Var. β, trichotoma. Fronde magis divisa, laciniis ciliisque longioribus.

"The var. α occurs almost exclusively on damp ground in cultivated fields; the var. β on rocky soil, associated with the var. of the preceding species [*R. arvensis*, var. *hirta*, now *R. hirta*], and with *R. sorocarpa* and *R. lamellosa* [now considered distinct from the European *R. lamellosa* Raddi and known as *R. Austini* Steph.].

"*R. palmata*, Lindbg., a closely related species [now included among the synonyms of *R. Michelii* Raddi], is described as having the frond palmately lobed and the divisions broadly sulcate, with the ciliae arranged in a single series. *R. Bischoffii*, Hu[e]ben. [a European species], has the margin of the frond membranaceous, the lobes much expanded, and spores twice as large. The var. α has much the appearance of *R. bifurca*, Hoffm. [a European species], as figured in Lindbg. Monogr. d. Ricc. T. XX, f. 1, but that has the margin of the frond naked."

4. RICCIA ARVENSIS Aust. Proc. Acad. Nat. Sci. Philad. **1869**: 232. 1869

"R. fronde solida subciliata incrassata orbiculari subradiatim pluries divisa subgregario-imbricata in diametro 4–8 lineari, supra papuloso-reticulata obscure viridi vel demum secus margines purpurea, subtus nuda vel obsolete squamosa valde obtuseque carinato-incrassata ob sporangia tumentia valde nodosa; lobis obtusiusculis obsolete emarginatis lineari-ellipticis vel fere linearibus dichotomis versus apicem incrassatum leniter dilatatis, apice in statu juniori subadscendentibus vix canaliculatis, in aetate horizontalibus subcompresso-acuminatis evidentius lateque sulcatis, margine planis acutis (in adspectu incrassatis obtusisque); ciliis albidis brevissimis omnino inconspicuis subobsoletisve; fructibus primum versus apicem loborum infra canalem agregatis, sporis angularibus fusco-atris reticulato-muricatis.—*Hep. Bor. Amer. Exsic. ined.*, *No.* 141.

. . . . . .

"On damp ground in cultivated fields . . . about Closter, New Jersey, common.

"The canal occupies about ⅓ of the upper surface of the frond, and has a plane or slightly convex bottom with abrupt sides.

That portion of the frond between the canal and the acute margin is slightly convex above *as if thickened*. The typical form appears to be near *R. paradoxa*, De Not. [now included among the synonyms of *R. Michelii* Raddi], but that is described as being a smaller species, and the spores are said to be light-red. . . . The sporangia are placed rather towards the apex of the lobes as in *R. palmata* Lindbg.; which appears to be a larger species, with the lobes of the frond concave-canaliculate above, &c., and seems to be intermediate between this and the following species [*R. Lescuriana* Aust., now *R. Beyrichiana*]."

HABITAT: in fields and wet broken ground; common.

DISTRIBUTION: New Hampshire and Ontario to Indiana and Texas.

EXSICCATAE: Aust. Hep. Bor.-Am. *141;* Haynes, Am. Hep. *2, 98*.

5. RICCIA HIRTA Aust.; Underw. Bot. Gaz. **19**: 274. 1894

Riccia arvensis hirta Aust. Proc. Acad. Nat. Sci. Philad. **1869**: 232. 1869.

"Var. *β*, hirta. Statura majora, fronde subtus magis purpurea et squamigerula margine evidentius ciliata, supra omnino hirta.—*Hep. Bor. Amer. Exsic. ined., No.* 142.—*R. hirta*, Aust. MSS. 1864.

". . . (the var.) in rocky places about Closter, New Jersey.

". . . The var. differs from *R. cilifera*, Link. [a synonym or variety of *R. Bischoffii*], in the fronds being purple and more or less scale-bearing underneath, and not membranaceous on the margin."

HABITAT: moist rocky ground.

DISTRIBUTION: Connecticut to Louisiana and Texas.

EXSICCATAE: Aust. Hep. Bor.-Am. *142* (*p.p.*, as *R. arvensis* var. *hirta*).

6. RICCIA CURTISII James (Aust. Proc. Acad. Nat. Sci. Philad. **1869**: 231. 1869, as synon.) Steph. Bull. Herb. Boiss. **6**: 369. 1898

This was originally described as representing a new genus, *Cryptocarpus* (afterwards changed to *Thallocarpus* by Lindberg*), as follows:

"CRYPTOCARPUS, (gen. nov.) Aust. MSS., 1864.

"Frons laxe spongioso-reticulata, irregulariter subpalmatim lobata, tenuis, epidermide haud distincta. Costa nulla. Radices

* Not. F. et Fl. Fenn. **13**: 377. 1874.

intus non papillosi (ut in *Sphaerocarpo*), longissimi, intertexti. Fructus in frondis substantia immersus (ut in *Riccia*). Sporangia depresso-globosa, singulatim nata, non libera. Calyptra stylo nigro persistente coronata. Sporae 4-jugae (ut in *Sphaerocarpo*), vix solutae, in aspectu singulae et profunde quadrilobae.

"A genus intermediate between *Riccia* and *Sphaerocarpus*, having the characters of vegetation and spores of the latter, while the fruit is immersed in the frond as in the former genus. Represented by a single species, which occurs both in the Southern States and in France.

"CRYPTOCARPUS CURTISII, Aust. MSS., 1864.

"*Riccia Curtissi*, James, in Herb. (fide Curtis).

"Fronde caespitosa valde imbricata fibroso-papulata, laciniis inciso-lobulatis margine crenatis; sporangiis maximis in statu siccati latentibus sed frondes humefactae sunt in substantia earum ut maculis nigris apparentibus; sporis fusco-nigris valde muricatis.

"On moist ground, South Carolina, Ravenel (in Herb. Sulliv., 1849) North Carolina, Curtis (l.c., 1853). 'Montand après Marseille' (Herb. Lanning, 'ex. Herb. Torrey').

"To the naked eye the dried specimens look like little heaps of some filamentose conferva. In this state the frond is very brittle, and, on account of its loose texture, appears to be deeply pitted and fibrose and papulose above. Upon moistening the specimens the fronds become tough (much as in the *Anthoceroteae*), the upper surface looses its pitted appearance, and the interstices (apparent fibres) between the large cells close up; and the fruit, which was completely hidden before, now appears as a black spot in the substance of the frond. Upon re-drying the specimens the fronds become much thinner than they were at first, and the fruit remains visible, protruding from the upper surface. The frond is larger than in *Sphaerocarpus Michelii*, from the Southern States, but lobed and reticulated in the same manner. The extreme apices of the lobes are often suddenly contracted and subsolid (much as is often seen in the Anthoceroteae). The base of the divisions are contracted and subsolid, and the rootlets are smooth on the interior surface as in *Sphaerocarpus*. The divisions are flabelliform, and palmately or incised-lobed, and lie

so closely over one another as to be separated with difficulty, the upper ones, by their numerous long rootlets, knitting firmly to the pitted surface of those immediately beneath them. The lobes are crenate and obtuse, not emarginate, extremely thin and hyaline. Spores firmly united in fours into a sort of *coccus* which is deeply 4-lobed, and very beautiful under the lens,—more deeply lobed than in *Sphaerocarpus terrestris* and more finely reticulated and papillose."

TYPE LOCALITY: North Carolina.

DISTRIBUTION: North Carolina to Florida and Texas.

ILLUSTRATIONS: Bull. Torrey Club 43: *pl. 4.* 1916.*

EXSICCATAE: Underw. & Cook, Hep. Am. *43* (as *Thallocarpus Curtisii*).

Appreciative thanks are due to Dr. Howe and Professor Evans for valued assistance, to the Rev. E. E. Brooks for a translation, and to Mr. Severin Rapp for specimens of *R. Donnellii* and *R. Curtisii*, collected at different periods of the year.

HIGHLANDS,
NEW JERSEY

Explanation of plates 10-13

PLATE 10

RICCIA DONNELLII Aust.

FIG. 1. Dorsal side of an unusually large mature plant, showing several capsules; in older parts, walls rupturing and spores scattering; hyaline marginal pappillae plainly visible. Drawn from dry material. × 4.

FIG. 2. Ventral side of a thallus, showing beginnings of tuberiferous or resting stage not uncommonly met with in collections made in January and February. Drawn from fresh material. × 4. Austin's original description mentions this tendency to thicken ventrally at the apex of the axis, which is "greatly thickened and blunted as it grows downwards." This fact has been lost sight of in more recent descriptions.

FIG. 3. Portion of epidermis, with marginal cilia. × 47.

FIG. 4. Dorsal side of old fruiting plant, through the transparent wing of which the well-developed stalked tuber is seen arising from the ventral apex of the costa. × 4.

FIG. 5. Unusually well-developed tuberous prolongation of the costa, showing rudimentary scales. ×19.

FIG. 6. Cross-section near apex of a tuber. × 9.

FIG. 7. Outline of a cross-section of thallus. × 19.

FIG. 8. Portion of epidermal layer, in cross-section, drawn from fresh material. × 120.

* See McAllister, F. The morphology of *Thallocarpus Curtisii*. Bull. Torrey Club 43: 117–126. *pl. 4.* 1916.

FIG. 9. Scale. × 33.

FIGS. 10 and 11. Spore, outer and inner faces, showing irregular and anastomosing ridges. × 265.

FIG. 12. Spore, showing outer face with light reticulations or shallow pits in middle portion. × 265.

FIG. 13. Spore, showing outer face with markings similar to those of 10. × 265.

FIG. 14. Spore, showing inner triangular faces. ×265.

FIG. 1 was drawn from a specimen in the herbarium of the New York Botanical Garden, from Jacksonville, Florida, Underwood & Cook, Hep. *42*; FIGS. 2 and 3, from a specimen collected by Severin Rapp, at Sanford, Florida, February 7, 1913; FIGS. 6, 8, and 9, from a specimen collected by Severin Rapp, at Sanford, Florida, May 9, 1912; FIGS. 4, 5, 7, 10, and 11, from a specimen collected by Severin Rapp, at Sanford, Florida, January, 1904, and communicated by Herr F. Stephani; FIGS. 12, 13, and 14, from a specimen in the herbarium of the New York Botanical Garden, collected at Jacksonville, Florida.

PLATE 11

FIGS. 1–5. RICCIA DICTYOSPORA M. A. Howe

FIG. 1. Plant colony, drawn from fresh material. × 4.

FIG. 2. Plant twisted in growth, showing latero-ventral scales. × 33.

FIG. 3. Outline of cross-section of thallus. × 19.

FIG. 4. Spore, outer face. × 390.

FIG. 5. Optical section of spore, showing difference in height of papillae, the the upper side of figure representing the outer face. × 390.

FIGS. 1 and 3 were drawn from plants collected by C. C. Haynes, on West Rock, New Haven, Connecticut, October 12, 1911; FIGS. 2, 4, and 5, from type material, R. M. Harper *68a*, Athens, Georgia, June 26, 1900.

FIGS. 6–11. RICCIA BEYRICHIANA Hampe

FIG. 6. Plant colony, drawn from fresh material. × 4.

FIG. 7. Outline of cross-section of thallus, showing cilia. × 19.

FIG. 8. Cells and cilia seen in cross-section of thallus. × 19.

FIGS. 9 and 10. Spore, outer and inner faces. ×390.

FIG. 11. Spore in profile showing bold markings on outer face. × 390.

FIGS. 6, 7, and 8 were drawn from a specimen collected by C. C. Haynes, on West Rock, New Haven, Connecticut, October 21, 1911; FIGS. 9, 10, and 11, from a specimen collected by Annie Lorenz, at Hartford, Connecticut.

PLATE 12

FIGS. 1–6. RICCIA ARVENSIS Aust.

FIG. 1. Plant colonies, drawn from fresh material. × 4.

FIG. 2. Outline of cross-section of thallus. × 20.

FIG. 3. Portion of epidermal layer in cross-section. × 155.

FIG. 4. Portion of epidermis, showing rarely occurring cilia. × 87.

FIG. 5. Spore, outer face, showing areolate-alveolate markings and crenate or crenulate wing. × 390.

FIG. 6. Portion of wing with crenulate margin seen in optical section. × 390.

FIG. 1 was drawn from a specimen collected by C. C. Haynes, at Hartford, Connecticut, October 20, 1911; FIG. 2, from a specimen collected by Fred Donaghy,

Harrodsburg, Indiana, February 20, 1915, in the herbarium of the New York Botanical Garden; FIGS. 3 and 4, from a specimen collected by C. C. Haynes, Highlands, New Jersey, October 7, 1911; FIG. 5, from a specimen collected by A. W. Evans, Orange, Connecticut, October, 1899, Haynes, Am. Hep. *2*; FIG. 6, from a specimen collected at Closter, New Jersey, by C. F. Austin, Hep. Bor.-Am. *141*.

FIGS. 7–13. RICCIA HIRTA Aust.

FIG. 7. Plant colony, drawn from fresh material. × 4.

FIG. 8. Outline of cross-section of thallus, showing two cilia. × 33.

FIG. 9. Portion of epidermal layer in cross-section. × 265.

FIG. 10. Portion of epidermis showing two cilia. × 87.

FIG. 11. Spore, outer face. × 390.

FIG. 12. Spore, inner faces. × 390.

FIG. 13. Outline of spore in profile showing papillae on outer face, represented by upper side of figure. × 390.

FIG. 7 was drawn from a specimen collected by Annie Lorenz, Meriden, Connecticut, November 12, 1911; FIGS. 8, 9, 10, and 11, from a specimen collected by Annie Lorenz *956*, West Hartford, Connecticut, October 8, 1911; FIGS. 12, and 13 from a specimen collected by F. V. Coville, Georgetown, District of Columbia, December 24, 1889.

PLATE 13

RICCIA CURTISII James

FIGS. 1 and 2. Plant colonies, showing archegonial (larger) and antheridial (smaller) plants. × 4.

FIGS. 3 and 4. Outlines of simple plants, showing capsules. × 4.

FIGS. 5 and 6. Epidermal cells, dotted and heavy lines indicating lamellae, forming walls of the air-chambers. × 240.

FIG. 7. Outline of portion of thallus in cross section. × 4.

FIG. 8. A portion of thallus in cross section. × 33.

FIG. 9. Spore tetrad, showing very blunt papillae and very low connecting basilar ridges. × 307.

FIG. 10. Spore, covered with more conical papillae. × 307.

FIGS. 1, 3, 5, and 9 were drawn from a specimen collected by Mary Young, Austin, Texas, March 3, 1914; FIGS. 2, 6, and 8, from a specimen collected by Severin Rapp, Sanford, Florida, May 2, 1912; FIGS. 4 and 10, from a specimen collected by Severin Rapp, Sanford, Florida, April 12, 1911; FIG. 7, from a specimen collected by Severin Rapp, Sanford, Florida, December 12, 1911.

A week in eastern Texas

ROLAND M. HARPER

(WITH FIVE TEXT FIGURES)

INTRODUCTION

Diversity of the coastal plain in Texas.—Of the fifty or more geographical divisions of the coastal plain of the eastern United States, differing significantly in soil, topography, vegetation, etc., very few extend through more than two states, or are as much as two hundred miles in longest dimension; and none of the divisions in Texas, with the possible exception of the red hills in the extreme east, can be closely correlated geographically with anything east of the Mississippi River. The number of natural regions in the Texas coastal plain, between the Red River on the north, the Sabine on the east, and the Rio Grande on the southwest, cannot yet be stated with exactness, but must be at least a dozen. The first noteworthy attempt to map them seems to have been that of Dr. R. H. Loughridge, in his report on cotton production in Texas, in the 5th volume of the Tenth Census, 1884 (colored map facing page 671).* This covered the whole state, and is probably more accurate for the coastal plain than for the remainder, for there were no railroads in the western half of the state in those days. In the accompanying text the various regions were described, with reference to soils, vegetation, agriculture, etc.

In 1900 Robert T. Hill published in "Topographic Folio No. 3" of the U. S. Geological Survey an excellent regional map of Texas and part of New Mexico and what is now Oklahoma, which has been copied by some of the other writers referred to below;† but

* A worthy successor to Loughridge's map is a colored soil map of the principal cotton-producing regions of the United States, by H. H. Bennett, on page 8 of the section of the folio Atlas of American Agriculture devoted to cotton, published by the U. S. Department of Agriculture early in 1919.

† The same map appeared the following year as Plate 1 (opposite page 26) of a ponderous monograph on the Black and Grand Prairies of Texas by the same author, which constitutes Part 7 of the 21st Annual Report of the U. S. Geological Survey, and is more accessible than the Topographic Folio.

he recognized at that time only four or five divisions in the coastal plain. Vernon Bailey, in his "Biological survey of Texas" (U. S. Dept. Agriculture, N. Am. Fauna No. 25. Oct., 1905), discussed the distribution of plants and animals (mainly the latter) in the same territory mapped by Hill, with special reference to climate, paying very little attention to the pronounced contrasts of soil, and using a colored map that treats the whole coastal plain of Texas, east and north of a line drawn through Austin and Victoria, as a unit, under the designation of "Austroriparian" area. (The "life-zone" system of the U. S. Biological Survey, being based on climatic factors, does not work out very satisfactorily in non-mountainous regions.) In the text, however, Bailey admits that the country near the coast has some subtropical characteristics, and that the flora of the black prairie, coast prairie, marshes, islands and beaches is different from that of the wooded portions of the humid area.

Another important geographical work, covering approximately the same territory as the present paper, is "Geology and underground waters of the southeastern part of the Texas coastal plain," by Alexander Deussen (U. S. Geol. Surv. Water Supply Paper 335, with 365 pages and 9 plates. 1914). This includes a pretty good though brief account of the regional geography, with a few notes on the forest growth. Additional information of a similar nature may be gathered from several state and government geological reports which do not need to be enumerated here, and from the government soil surveys of various counties.*

A recent study in regional geography, covering the whole state, is "Studies in the industrial resources of Texas," by L. H. Haney and others, constituting University of Texas Bulletin 3 of the 1915 series, with 105 pages, and including a map which divides

* Since this manuscript was sent to the editor there has appeared University of Texas Bulletin 1869 (i.e., no. 69 of the 1918 series), on The geology of East Texas, by E. T. Dumble, comprising 396 pages, 9 half-tone plates, and 3 loose maps. (It is dated Dec. 10, 1918, but does not seem to have been published until March, 1920.) On page 271 is mentioned a more or less interrupted tongue of the coast prairie extending inland to the northwestern portion of Liberty County, but the information came too late to be utilized in drawing my map, and is hardly definite enough anyway. Sundry other references to prairies, mounds, salt licks, rock outcrops, etc., scattered through the bulletin are of some botanical interest.

the state into eleven regions and indicates land values for each county by shading.*

Geological and climatic relations.—From Pennsylvania to Alabama there is a vast geological hiatus at the fall-line, between the metamorphic rocks of the Piedmont region (and Triassic sedimentary strata for part of the distance across North Carolina) and the unindurated Cretaceous and later strata of the coastal plain. From Alabama to Illinois and Oklahoma the coastal plain formations at the fall-line abut against Paleozoic strata, which although mainly horizontal and unaltered are characterized by an abundance of hard rock, something that is relatively scarce in the coastal plain. In Texas, however, the fall-line is hard to define, for strata of Cretaceous age in practically uninterrupted series extend from the unquestioned coastal plain area far into the interior, merging into the southern extremity of the Great Plains, a province whose rocks are mostly of the same age as the coastal plain strata, but nearly as hard on the average as those of Paleozoic age. But in Texas it is customary to place the boundary of the coastal plain somewhat arbitrarily at the inland edge of the black prairie belt (described farther on). From the vicinity of Austin southwestward this boundary corresponds pretty closely with a displacement known as the Balcones fault, which marks a rather abrupt transition from the undulating black prairie to the rocky hills of the Edwards Plateau.

As in Alabama, Mississippi and Louisiana, the distribution of vegetation and other biotic features in Texas can be correlated pretty well with geological formations, although there are some discrepancies between existing geological and vegetation maps, which however may diminish with the progress of exploration. But in Texas one encounters an environmental factor that does not occur in the coastal plain anywhere farther east (except to a limited degree on the Florida Keys), namely, aridity. The isohyetal line of 35 inches annual rainfall, which with the temperature prevailing in that latitude marks approximately the transition from humid to semi-arid conditions, passes through or

* A review of this by F. V. Emerson (Geog. Review 2: 384–385. Nov. 1916) reproduces the same map, and may be more accessible to some readers.

near Austin and thence in a southeasterly direction to the Gulf coast.* The trip on which the present paper is based did not take me southwest of Austin, and consequently the following observations are practically confined to the eastern forest region, with ample rainfall.

Previous botanical work in eastern Texas.—The humid portion of Texas (which is approximately the northeastern two thirds of the coastal plain), although it is the most thickly settled and accessible part of the state, has received proportionately much less attention from botanists than the semi-arid portions; presumably mainly because the great majority of the plants there occur also east of the Mississippi River, so that collectors entering Texas from the East have generally pushed on to the drier regions in search of novelties.

This state of affairs is well illustrated by a brief history of botanical investigation in Texas, with a bibliography of about 125 titles, by Charles H. Winkler, constituting University of Texas Bulletin 18 of the 1915 series. Of the works cited therein, 21 are hard to classify or of doubtful value as far as descriptions of the vegetation or flora are concerned, several of them dealing with only one species; 38 relate to Texas and some additional territory besides, chiefly New Mexico or Mexico, or both; 25 cover the whole state, if only for trees or some one family of plants; 34 are restricted to the regions with limited rainfall, and only 7 to eastern Texas alone. If omitted papers (some of which are mentioned farther on) and those published since were added it would not change these proportions much.

Between 1892 and 1896 E. N. Plank contributed to Garden and Forest twenty-nine narratives of botanical trips in Texas (all of which were overlooked by Winkler), but only four or five of these pertain to the humid portions of the state. (In the ten volumes of that magazine there are a few other Texas articles, but apparently none of them touch the area under consideration.)

Professor William L. Bray, while at the University of Texas, sketched the forests of the whole state in 1904 in Bulletin 47 of the U. S. Bureau of Forestry, and again early in 1907 in Bulletin

* See Vernon Bailey's map previously referred to and also the precipitation maps in some of Professor Bray's papers cited farther on.

82 of the University, entitled, "Distribution and adaptation of the vegetation of Texas," using in the latter some of the same halftone illustrations as in his government bulletin, but including notes on shrubs and herbs as well as trees, more ecological speculations, and an abridged bibliography of twenty titles.

A noteworthy paper on eastern Texas vegetation, not cited by Bray or Winkler, is by the late James E. Gow, on "An ecological study of the Sabine and Neches Valleys, Texas" (Proc. Iowa Acad. Sci. **12**:39–47. *pl. 9–11.* 1905). This divides the vegetation of the area treated (which was mainly in the long-leaf pine region) into six habitat groups, and lists the common trees and a few other plants in each. About the same time appeared U. S. Forest Service Bulletin 64, on "Loblolly pine in eastern Texas," by Raphael Zon, which maps one of the other regions discussed herein and describes the condition of its forests in considerable detail from the standpoint of the professional forester.

J. H. Foster, while state forester, published in 1917, jointly with his assistant H. B. Krausz and one or two others, two useful illustrated bulletins: No. 3, "A general survey of Texas woodlands," and No. 5, "Forest resources of eastern Texas." The first contains a small but pretty good soil map of the state, by a local specialist, and a small map of the forest regions of the coastal plain portion, which fits geographical conditions better in some respects than the maps prepared by geologists and soil investigators.

One of the few "local floras" for eastern Texas is "A list of trees and shrubs occurring in the vicinity of Huntsville, Texas," by Carl Hartman (Trans. Texas Acad. Sci. **12**[2]: 66–90. 1913). This is an annotated catalogue of 62 trees, 24 shrubs, 18 woody vines and two herbaceous vines, but includes 25 introduced or cultivated species, and a few of the shrubs seem to be wrongly identified. An interesting feature of the list is that nearly all the species range far to the eastward, but many of them not much farther westward, showing that the locality is near the western edge of the humid area.

Investigations of the writer.—In July, 1915, I crossed Texas from east to west where it is widest, but on one of the fastest trains, with little opportunity to study any of the vegetation at close

range, and many of the characteristic plants were then unfamiliar to me. In the summer of 1918 a trip through the coastal plain from Virginia to Texas, for the purpose of collecting *Ilex vomitoria* from representative localities for the U. S. Department of Agriculture,* gave me a long-desired opportunity to investigate some of the interesting phytogeographical problems of the "Lone Star State." On this trip I spent a week in Texas, taking notes on the vegetation of at least twenty counties, and walking around in the forests and prairies of four or five of them, where I could thus make more accurate guesses as to the identity of unfamiliar species than was possible from a train. On account of the large territory to be covered in a short time it was not practicable to carry any sort of manual with me or to collect miscellaneous specimens for subsequent identification, but Professor Bray had given me some useful information by letter before I started, and at the University of Texas Miss M. S. Young (since deceased), of the Department of Botany, helped identify a few of the plants that I described to her as having seen a few days before.

My itinerary in Texas in August, 1918, was as follows:

On the afternoon of the 20th I entered the state near the southeastern corner of Newton County by way of the New Orleans, Texas & Mexico Ry. (Gulf Coast Lines)—which comes into Texas on the Kansas City Southern tracks—and stopped at Beaumont, about 25 miles farther on. On the 21st from Beaumont to Port Arthur (about 20 miles) by trolley car, and back the same way except for getting off and walking a few miles through the coast prairies, from Neches Junction to Nederland. On the 22d from Beaumont to Kountze, 25 miles northwestward, by the Texas & New Orleans R. R. (Southern Pacific system), and after exploring the long-leaf pine forests around Kountze for a few hours I went westward by the Gulf, Colorado & Santa Fe Ry., getting well into Montgomery County by nightfall, changing to the H. & T. C. at Navasota, and arriving at College Station about midnight. On the 23d from College Station to Valley Junction and Austin by the International & Great Northern Ry. The 24th

* For an account of some of the results of the trip, see F. B. Power and V. K. Chestnut, *Ilex vomitoria* as a native source of caffeine. Jour. Am. Chemical Soc. 41: 1307–1312. Aug., 1919.

was spent in the vicinity of Austin, part of the time outside of the coastal plain.

On the 25th I went from Austin to Hempstead and Houston, by the Houston & Texas Central R. R. (Southern Pacific). On the 26th from Houston to Columbia by the I. & G. N. Ry., 50 miles, then on foot down the right side of the Brazos River eight or ten miles, to Brazoria, and back to Houston by the St. Louis, Brownsville & Mexico Ry. (Gulf Coast Lines), which uses the Santa Fe tracks the last 28 miles or so. On the 27th from Houston to the Sabine River at Logansport, Louisiana, by the Houston East & West Texas Ry. (Southern Pacific), and on northeastward into Louisiana.

Seven or eight regions were studied sufficiently to be described briefly in this paper, but of course I did not cross their boundaries at enough points to warrant any attempt to revise the regional maps already referred to. The small map published here (FIG. 1) will help the reader to follow the regional descriptions, but in itself can not be regarded as contributing anything new to the knowledge of Texas geography. Two or three of the regions crossed will require further study before they can be described, and for one of them (which may be divisible into two or more) I have not even found a suitable name.*

Observations in the vicinity of Austin.—Near Austin, the only place where I crossed the boundary of the coastal plain in Texas, there is a great contrast between the rocky and almost uninhabited Edwards Plateau west of the city and the undulating and highly cultivated black prairie to the eastward. On the limestone hills I found myself in dwarf forests or thickets as strange to me as were the tropical hammocks south of Miami, Florida, when I first encountered them in the spring of 1909.† This vegetation has been described at considerable length by Professor Bray in some of his best-known papers, and I can add no facts of importance about it. No doubt some of the characteristic species can

* This difficulty is much like that of a taxonomist who monographs a genus or family and finds a few specimens that cannot be referred to known species but cannot be described for lack of information about some of their essential characters.

† In this connection see the chapter entitled "Bewilderment" (pp. 96–103) in Bradford Torrey's book "Nature's Invitation" (Boston, 1904), which describes the author's first experience with the subtropical flora near Miami.

be found at isolated stations farther east (though I have looked in vain in the botanical literature for any definite information on that point), but for all practical purposes the ranges of many must terminate right there.

There is one plant of that neighborhood which deserves special mention here, however. From Palm Valley to Austin, some twenty miles, the International & Great Northern Ry. runs practically on the fall-line, and along there, as well as in a few other

FIG. 1. Map showing approximate location of the regions described herein and routes of the author in 1915 and 1918. Scale about 1 to 4,700,000, or 75 miles to the inch.

places near Austin, a small species of *Tillandsia* was conspicuous on the branches of live oaks. By Texas botanists this has been referred without question to *T. recurvata* L., but it differs from that species as represented in Florida in being more densely tufted, and especially in its environment. It has been made the subject of a special study by Willie I. Birge,* with a map of its

* The anatomy and some biological [*sic*] aspects of the "ball moss," *Tillandsia recurvata* L. Univ. Texas Bull. 194. 24 pp., 10 pls. "Aug. 8, 1911." (Apparently published about the beginning of 1912.)

known distribution in Texas, showing that it extends north to about latitude 31° in Bell County, but no farther east than Fayette and Lavaca Counties, being thus practically confined to the semi-arid regions.* The corresponding plant in Florida is confined to the peninsula, mainly south of latitude 30°, where the average annual rainfall exceeds 50 inches. (There it often grows on insulated wires, which perhaps it does not do in Texas.) The Texas plant at its northern limit must be subject to much colder winter weather than the Florida one, too. If it was all one species there would be no good reason apparently why it should not be found also in Louisiana, Mississippi and Alabama, like *T. usneoides*, with which it is often intimately associated. This seems to be a good opportunity for some taxonomist to investigate and make a new species or subspecies.

REGIONAL DESCRIPTIONS OF THE COASTAL PLAIN

The various divisions of the coastal plain, whose vegetation was studied from the train, will now be taken up as nearly as possible in geological order, beginning at the fall-line and ending at the coast. As usual the plants listed will be divided into trees, shrubs, herbs, etc., and arranged in approximate order of abundance in each group, with the rarer species omitted. The names of evergreens (or in the case of semi-evergreens only the specific names) are printed in heavy type, to suggest the winter aspect of the forests, and those of weeds enclosed in parentheses, so that the reader who may wish to picture to himself the appearance of the original vegetation can skip them.

The black prairie belt is one of the most distinct natural regions in Texas, and it has been delineated pretty accurately on quite a number of maps, geological and otherwise. It corresponds with the area of outcropping of certain upper Cretaceous limestones, plus a strip, a few miles wide at the eastern edge, of the lowest Eocene strata (Midway formation), which is equally calcareous and has very similar soils except for being perhaps a little more rocky. (This strip has been designated by Hill and Deussen as

* This is commented on by Miss Birge on page 8 of her paper as follows: "It is quite evident that *Tillandsia recurvata* demands a semi-arid rather than a swampy environment to which Small in his *Flora of the Southeastern United States* entirely confines it."

the eastern marginal prairie.) The topography is undulating to moderately hilly, and the prevailing color of the upland soils is black or very dark gray. The soil is so fertile that the greater part of the area is cultivated now,* but from all accounts it must have been originally a typical prairie, for there seems to be no record of any forest except along streams and in rocky places.

Many geographical details about this region, with occasional references to vegetation, can be found in Hill's monograph on the Black and Grand Prairies and Deussen's Water Supply Paper 335 previously cited. Published botanical information is rather meager, the writer having found nothing better in that line than a list of a few of the characteristic plants published by Pammel in 1893,† and another short list in Bray's Bulletin 82.

The species observed most frequently from the train, between the eastern edge of Williamson County and Palm Valley, and between Austin and the eastern corner of Travis County, in August, 1918, were as follows:

SMALL TREES

Prosopis glandulosa — *Hicoria Pecan*
Ulmus crassifolia — *Salis longifolia?*

SHRUBS AND VINES

Opuntia Engelmanni — *Vitis cinerea*
Aloysia ligustrina?

HERBS

(*Euphorbia marginata*) — (*Sorghum halapense*)
(*Ambrosia trifida*) — *Petalostemon* sp.
(*Helianthus annuus*) — (*Tribulus terrestris?*)
(*Xanthium* sp.)

Few if any of these are typical of the original vegetation of the black prairies, for the trees and shrubs are chiefly confined to rocky places, and the herbs are nearly all weeds. Most of the herbs were pretty well dried up (like the corn mentioned a little farther on), but in a wetter season doubtless more species could have been recognized.

* Over 60 per cent of the area of the black prairie counties was classed as "improved land in farms" in 1910, and along my route, in Williamson and Travis Counties, the proportion must be above the average, for I would have guessed it to be something like 90 per cent.

† Proc. Iowa Acad. Sci. 1[3]: 62. 1893.

This region has been correlated by geologists and soil investigators with a well-known belt of similar age in Mississippi and Alabama, but it differs widely from that in some features of soil, vegetation, population and agriculture. In the eastern black belt the black soils are limited in extent and chiefly confined to low grounds, while in the Texas area black is the prevailing color even on the uplands. The eastern belt has most of its rain in winter and spring, and the western in early summer. The originally treeless areas probably did not cover more than 10 per cent of the black belt in Alabama and Mississippi, while the Texas black belt must have been nearly all prairie. In the black belt of Alabama about three-fourths of the inhabitants are negroes (which has led some persons in other states to imagine that its name referred to that fact), while in the corresponding part of Texas negroes constitute only about one sixth of the total.

In the last ten years or so, since the coming of the boll-weevil, the cotton fields of central Alabama have largely given way to hay and pasture; but in the black belt of Texas, which has had the weevil much longer, cotton is still king, and there is very little pasture, at least in the latitude of Austin. In 1909–1910 the average farm in that region had about 32 acres of cotton and 15 of corn out of a total of 64.5 "improved," and the yield of both was above the state average. At the time of my last visit the precipitation had been below normal for several months over most of Texas, and the corn-stalks standing in the fields, from which the "fodder" had been "pulled" some time before, were bleached to a pale straw color, contrasting strongly with the black soil; while the cotton in neighboring fields, though short of stature, was full of healthy dark green leaves: and I do not remember ever seeing paler corn or greener cotton plants.

In this region I was impressed with the neat and prosperous appearance of the farm-houses, which appeared almost equal to those of Illinois. On digging out statistics later from census reports I found that the average value of farm buildings in 1910 in 15 black prairie counties of Texas was only $592 ($641 for whites*

* If we had figures for Anglo-Saxons alone the building values for that race would be higher than those given above, for the white population of this part of Texas includes quite a number of Mexicans (not separated in the census unless they happened

and $241 for negroes), which seems rather low; but the two counties that I crossed are above the regional average in that respect, and there may also have been some improvement between 1910 and 1918. Windmills, another token of moderate prosperity, are much more frequent in the black prairie belt than in the regions farther east.

The Lignitic belt.—At the eastern edge of the black prairies as above defined there is a pretty sudden transition to a non-calcareous belt, about 15 miles wide in the latitude of Austin but wider northward, characterized by Eocene strata of the Wilcox formation (Lignitic of the older geologists), which give rise to rather sandy soils with pale clayey subsoils. There is also a good deal of ferruginous sandstone, similar to that which can be seen on many non-calcareous uplands in the coastal plain from New Jersey to Mississippi. Quite a number of lignite mines and brick and tile plants can be seen from the train, and the domestic water supply is mostly from dug wells, indicating pretty good water—something that is not very abundant in Texas. On account of the comparatively poor soil, only about one fourth of the area is cultivated (30.5 per cent improved in 1910 in a few selected counties, all of which include parts of more fertile regions on either side).

I crossed this belt in 1915 in Caldwell and neighboring counties, and in 1918 in Milam and Bastrop, but only the 1918 notes are used here. The vegetation has little in common with that of the black prairies. *Quercus stellata* constitutes about two-thirds of the forest and *Q. marylandica* about one third, and both are small, hardly fit for saw timber. No regular shrubs were noticed, but *Vitis cinerea* is a common vine, and *Daubentonia longifolia* (called *Sesbania Cavanillesii* by some of the older writers on Texas plants, such as Plank), a tall woody herb or short-lived shrub, is a common weed. The prevailing herbs are about as follows:

Andropogon scoparius	(*Sesbania* sp.?)
(*Croton capitatus*)	*Baptisia leucophaea?*
Eupatorium compositifolium	(*Froelichia campestris*)
(*Helenium tenuifolium*)	

to be born in Mexico, though some of the counties provide separate schools for them as they do for negroes), and their standards of living are little if any higher than those of the negroes. In the Alabama black belt the average farm building values for whites and negroes in 1910 were $897 and $114, respectively.

An interesting feature of this belt is the occurrence, in its northern portions, of several "salt domes," which have attracted considerable attention from oil prospectors but which have apparently never been investigated botanically.*

An indication of the difference in soil fertility between this and the black prairie belt is that in 1909–10 the prairie farmers spent less than a third of a cent for fertilizers, for each acre of improved land, while those in the Lignitic belt spent a little over two cents an acre.

Areas of uncertain relationship.—East of the Lignitic belt and west of the Trinity River are the Fayette prairie and one or two other kinds of country that have not been accurately mapped, and whose boundaries I could not locate satisfactorily in the short time available, especially when I crossed some of them at night. The belt in which College Station is situated seems to be characterized by buff-colored rather clayey soils of medium fertility, and very open forests of small oaks and other deciduous trees. The Fayette prairie resembles the black prairie in the color of its soil, but is flatter and less than half cultivated, with a larger percentage of negroes. Live oak growing in clumps or "motts" is a characteristic feature in some places. The yield of corn per acre, in a few counties selected as typical, is even higher than in the black prairie. The blackness of the soil is noteworthy, for it is derived from Eocene strata that are not as obviously calcareous as are the Cretaceous rocks of the black prairie. For some reason apparently not yet explained, almost any formation in Texas can make a black soil, just as in Alabama and Georgia many kinds of rock weather into red clay, and in Florida the final product is commonly sand. In some parts of eastern Texas one can see the curious combination of black soils and red subsoils. No doubt the complete explanation will have to take climate into consideration.

The red hills, or short leaf pine region.—This region, in the extreme eastern part of the state, is an extensive area characterized by Eocene strata a little younger than those of the Lignitic belt,

* For a description of one about a mile in diameter, in Freestone County, surrounded by a narrow strip of marsh grass, see E. DeGolyer, Jour. Geology (Chicago) 27: 647–663. *f.* 1, 2. "Nov.–Dec. 1919" [Feb. 1920].

which adjoins it on the west. The boundary between this and the nondescript country around College Station has not been definitely located, but is probably somewhere near the Trinity River. This region does not differ conspicuously from the Eocene red hill belt that extends from South Carolina to Mississippi, but it is separated from that by the width of the Mississippi River bottoms, a gap of about 100 miles.*

FIG. 2. Looking south from train at Hanson, Shelby County, about six miles from the Sabine River; a scene very typical of the red hill region as far as topography, general aspect of forests, and relative amount of cleared land is concerned. August 27.

The soil is usually reddish and loamy, the topography moderately hilly (see FIG. 2), and the country about one third cultivated. In 1909–10 about two thirds of the farmers were white, 28 per cent of the land "improved," and the average expenditure for fertilizers 13 cents an acre. The average yield of corn was about 13 bushels per acre, as in the Lignitic belt.

There seems to be very little information about this part of Texas in the botanical literature. Plank's "Botanical notes from

*For descriptions of portions of this belt east of the Mississippi, see Bull. Torrey Club 37: 411. 1910; 40: 386–388. 1913.

Texas, XXIV"* deals with Cherokee County, but mentions only about a dozen species of plants, and several of these are introduced. I crossed the region in going from Houston to Shreveport, and the country between Lufkin and the Sabine River (72 miles) may be considered typical. The following seem to be the commonest woody plants along the route just indicated.

LARGE TREES

Pinus echinata
Pinus Taeda
Quercus falcata
Liquidambar Styraciflua
Quercus stellata
Quercus marylandica
Hicoria alba
Quercus Phellos
Ulmus americana
Quercus alba
Quercus **nigra**
Nyssa sylvatica?

SMALL TREES

Salix nigra?
Morus rubra
Cornus florida
Cercis canadensis
Carpinus caroliniana
Magnolia glauca
Crataegus berberifolia?

SHRUBS AND VINES

Brunnichia cirrhosa
Rhus glabra
(Daubentonia longifolia)

As in many other wooded regions, the herbs recognizable from a train in summer are mostly weeds. *Helenium tenuifolium* seems to be the most abundant and *Croton capitatus* next, and the others are considerably scarcer.

The long-leaf pine region.—This lies south of the red hills, but not necessarily immediately adjacent thereto. (Not having passed directly from one to the other in Texas, I cannot say whether the transition is abrupt or there is some other kind of country between, as the geological maps suggest.) Its western limit seems to be in Polk County, though very likely there are scattered long-leaf pines outside the area indicated on the map. It does not correspond with any one formation on the latest geological maps, but its strata are approximately contemporaneous with the Altahama Grit of Georgia and probably not older than Miocene. The topography of the parts I saw is gently undulating, but it is said to be more hilly farther north. Running water is rather scarce, probably on account of the soil, which instead of being decidedly sandy and holding water long after a rain, as in the Atlantic pine

* Garden & Forest **8**: 72–73. Feb. 20, 1895.

forests, is usually a pale yellowish loam. The Neches River, which drains a large part of this region, seems to be less muddy than most other Texas rivers, however.

The government soil survey of the "Woodville area," made in 1903, describes an area ten miles square in Tyler County. There are notes on the pine timber in several papers on forestry, but previous descriptions of the vegetation as a whole are not very satisfactory. The scene of Plank's first Texas article, in Garden and Forest (5: 399) for August 24, 1892, is laid in Tyler County, but there is no mention in it of the characteristic herbs of the pine forests, or even of *Pinus palustris*, for that matter (which may indicate the presence of considerable areas of hardwood forest in the heart of the long-leaf pine region). Gow, in the paper already cited, listed 11 woody plants and 10 herbs as characteristic of long-leaf pine flats in winter and early spring, and two additional trees from pine uplands. Bray sketched the herbaceous vegetation briefly, on pages 84–85 of his University of Texas Bulletin 82, but listed only four or five species, and regretted his unfamiliarity with that part of the state.

Although the soil if seen without its vegetative covering would look pretty good, it is evidently below the average in fertility, as is the case nearly everywhere where *Pinus palustris* abounds. Improved land constituted less than 4 per cent of the total area in 1910, and the few farmers that cultivated it were then spending about 30 cents an acre for fertilizers, which is probably more than in any other equal area in the United States west of the 93d meridian. Over 70 per cent of the farmers were white, their farms averaged about 25 acres of improved land each (probably the smallest in Texas outside of irrigated districts), of which about three acres were devoted to cotton and ten to corn, and the yield of corn was about 15 bushels per acre.

My observations on this region in Texas were limited to near its southern edge, in Hardin County. As in near-by parts of Louisiana, *Pinus palustris* is practically the only tree on the uplands there, but the small dry waterways are bordered by strips of hammock-like vegetation, which might be regarded as extensions or prongs of the region next to be described. The following list is based on my walks around Kountze, the county-seat, on August

22, extending not more than two miles east, north and west of there, and a few miles of car-window notes southeast and west of the same place. Plants of all habitats, including weeds, are combined here, as in the preceding lists.

LARGE TREES

Pinus palustris
Pinus Taeda
Magnolia grandiflora
Liquidambar Styraciflua
Quercus alba
Quercus falcata
Fagus grandifolia
Nyssa biflora?
Quercus laurifolia
Quercus Michauxii
Hicoria alba

SMALL TREES

Magnolia glauca
Cornus florida
Ilex opaca

LARGE SHRUBS

Ilex vomitoria
Myrica cerifera
Cyrilla **racemiflora**
Liquidambar Styraciflua
Cephalanthus occidentalis
Callicarpa americana
Batodendron **arboreum**
Symplocos **tinctoria**

SMALL SHRUBS

Myrica pumila
Hypericum aspalathoides?
Ascyrum stans.
Magnolia glauca
Rhus Toxicodendron

FIG. 3. Virgin forest of long-leaf pine, with no other woody plants in sight about two miles northwest of Kountze, Hardin County. August 22.

HERBS

Andropogon furcatus?	*Euphorbia corollata*
Laciniaria acidota	*(Helenium tennifolium)*
Laciniaria pycnostachya?	*Mesosphaerum rugosum*
(Diodia teres)	*Diodia virginiana*
Chamaecrista fasciculata	*(Euphorbia maculata*)*
Eupatorium rotundifolium	*Rudbeckia hirta?*
Chrysopsis graminifolia	*Polygala mariana?*
Boltonia diffusa	*Helianthus angustifolius*
Pluchea foetida	*Eupatorium semiserratum?*
Solidago odora	*Chondrophora nudata*
Solidago nitida?	*Marshallia graminifolia*
Cracca spicata?	*Eryngium ludovicianum*
Eupatorium Mohrii?	*Nama corymbosum*
Linum floridanum?	*Baptisia leucophaea?*
Eupatorium tortifolium?	*Stylosanthes biflora*
Rhexia mariana?	*Ruellia humilis*

(and about 20 others)

All the trees except the first-named and also the large shrubs are chiefly confined to the hammocks, and most of the other species to the open pine forests, where they are subject to periodical fires, as in all other forests of long-leaf pine that I have seen. The scarcity of woody vines here, as in the eastern pine-barrens, is probably correlated with fire. The first herb listed is probably more abundant than all the others combined, but as it was not in bloom at the time, I could not be sure of the species.

A peculiar feature of the shrubby and herbaceous vegetation of the open pine forests is that some species which in Georgia and Alabama are chiefly confined to damp spots and others which are usually regarded as pronounced "xerophytes" here associate together either in hollows or on the highest spots; possibly because both situations become about equally dry in dry seasons. The only *Sarracenia* known in Texas, *S. Sledgei*, has been reported from (near?) Kountze by Professor Macfarlane† (who first distinguished it from *S. flava*), but I did not come across any place wet enough for it.

* Although one finds no statement to that effect in any of the manuals, the favorite habitat of this species seems to be railroad tracks. I have seen it in such situations in places as far apart as Massachusetts, Michigan, Florida and Texas.

† Engler's Pflanzenreich 4^{110}: 29. 1908. See also Jour. Elisha Mitchell Sci. Soc. 34, 119. 1918. (No proof of this last was sent to me, and consequently it contains several annoying typographical errors, most of which however are self-evident.)

My lack of books and collecting apparatus on this trip is reflected in the large number of interrogation points in the foregoing list, which however is probably the most complete hitherto published for this region. If there had been any descriptions of pine-barren vegetation in either Texas or western Louisiana to go by it would have facilitated the identification of the species, but previous botanical explorers of this region seem to have either visited it in winter, or concentrated their attention chiefly on the trees, or merely collected plants without trying to describe the vegetation. The great majority of the species identified grow also east of the Mississippi River, where there are scores of pine-barren plants that do not reach Texas. Consequently the Texas pine-barren flora is much less attractive to taxonomists than that farther east, which probably explains why so little has been written about it.

The hammock belt, or Pinus Taeda region.—The long-leaf pine region is bordered on the south and west by a belt of varying width containing what are probably the densest upland forests in Texas,* in which *Pinus Taeda* is more abundant than any other tree, and than it is in any other equal area west of the Mississippi River, apparently. This belt or region, which extends across two or three geological formations without much change, has been mapped pretty well by Zon in Bulletin 64 of the U. S. Forest Service, and by Foster and Krausz in their State Forester's Bulletins 3 and 5, previously mentioned. The boundary between this and the long-leaf pine region is very sharp where I crossed it, about twelve miles southeast and west of Kountze, even if it may be less sharp at other points. There does not seem to be any marked difference in topography, and the change can hardly be correlated with geology, but there must be a considerable difference in soil fertility.

In 1909–10 about 10 per cent of the area was classed as improved land (over twice as much as in the long-leaf pine region), and the farmers spent about 7 cents an acre for fertilizers, which is above the Texas average but less than a third as much as in the long-leaf pine region. Nearly half the farmers were negroes, and

* The term "Big Thicket" is said to be applied locally to part of this region, in Hardin and Liberty Counties.

this is probably not the most salubrious region in the state, particularly along the Trinity River, where there is an alluvial belt a few miles wide so fertile that few pines are to be seen. (The Trinity drains a considerable portion of the black prairie previously described, and must carry down a great deal of fertility to be deposited farther along its course.) The average value of farm buildings is lower than in any of the other regions here discussed, being, in 1910, $325 for whites and $123 for negroes.

My notes on the hammock belt happen to be more complete than for any of the other regions that I saw only from the train. I was in it from the Sabine River to Beaumont and about ten miles northwest thereof, and then from about twelve miles west of Kountze to a point in Montgomery County undetermined on account of darkness, and a few days later from about Humble to Livingston; giving about 125 miles of car-window notes in all. (On the 22nd I must have passed out of it soon after nightfall, probably about Conroe, for I could see by the light of the full moon that the country west of that point was more open than that to the eastward. Notes taken north of Livingston on the 27th have not been counted in the following list, for beyond that point I was too close to the edge of the region to see a typical section of it.)

The list of plants is as follows; and in reading it it will be well to bear in mind that the first tree listed seems to be several times as abundant as its nearest competitor, though it may not constitute as much as half of the forest.

LARGE TREES

Pinus Taeda	*Quercus stellata*
Liquidambar Styraciflua	*Hicoria alba*
Pinus echinata	**Quercus laurifolia**
*Nyssa biflora?**	*Hicoria Pecan?*
Magnolia grandiflora	*Quercus hybrida?*
Quercus Phellos	*Taxodium distichum*
Quercus falcata	*Platanus occidentalis*
Quercus alba	*Nyssa uniflora*
Quercus Michauxii	*Ulmus alata*
Quercus **nigra**	*Quercus pagodaefolia?*
Pinus palustris	

* In Florida *Nyssa biflora* seems to be a perfectly distinct species, but near its northern and western limits it is sometimes hard to distinguish from *N. sylvatica*.

SMALL TREES

Salix nigra?	**Ilex opaca**
Ostrya virginiana	*Cornus florida*
Planera aquatica	**Magnolia glauca**

SHRUBS AND VINES

Ilex vomitoria	**Myrica cerifera**
Sabal glabra	*(Daubentonia longifolia)*
Callicarpa americana	*Vitis rotundifolia*
Rhus copallina	

HERBS

(Helenium tenuifolium)	*Eupatorium compositifolium?*
(Croton capitatus)	*(Euphorbia marginata)*
Tillandsia usneoides	

It seems probable that this region has more species of timber trees than any other reasonably homogeneous area of the same size in Texas.* Nearly all of them are equally common as far east as Georgia—and most of them extend even to Maryland—but *Magnolia grandiflora* seems to be a little more abundant here than it is anywhere east of the Mississippi River. The abundance of *Ilex vomitoria* is rather surprising, for east of New Orleans its favorite habitat is sandy hammocks within a mile of salt water. The proportion of evergreens is pretty high, for Texas, presumably indicating soils below the average in fertility, though not the poorest in the state.

The coast prairie.—On the south, not far from the main line of the Texas & New Orleans R. R. (Southern Pacific) from Orange to Houston, the hammock belt passes gradually into the coast prairie, an extensive and interesting region which has never been adequately described botanically. There are some outlying bodies of pine in the prairies, and some isolated prairies within the edge of the timber belt; and the opinion has been expressed by competent observers that the forest is encroaching on the prairie, rather rapidly for a successional change. The prairie region extends inland nearly to Hempstead,† in Waller County, 100 miles

* Hartman, in the paper cited on a preceding page, enumerates 43 native species of trees from the vicinity of Huntsville.

† Very likely this name was derived indirectly from Hampstead Heath in England, like that of Hempstead, Long Island, which is in the only known prairie east of the Alleghanies, and Hempstead County, Arkansas, which contains a few areas of black prairie similar geologically to that in Texas.

from the coast and about 250 feet above sea-level. Generally speaking, it is a vast flat plain, diversified in many places by mounds about a foot high and a few yards wide and depressions or "hog-wallows" that are even flatter, and less frequently by shallow waterways and a few "domes" that are of about the same shape as the mounds but many times larger.*

Where the coast prairie extends farthest inland the soil is a sort of sandy loam, dry enough in places to afford a suitable habitat for a *Selaginella* of the *rupestris* group;† but toward the coast, with decreasing altitude, and also with heavier summer rain (which naturally counterbalances the evaporation more than the same amount in winter would‡), the surface becomes more and more marshy, and at the same time more clayey, though the reason for this is not quite so obvious. In color the soil varies from gray to brown and nearly black, and it must be quite fertile, though the tests of evergreen percentages and amount of improved land, which have been used for some of the foregoing regions, are hardly applicable.

The greater part of the area has never been cultivated (in 1910 only about 40 per cent of it was in farms and 14 per cent improved), but there is a surprisingly large number of weeds, perhaps attributable to over-grazing, although very few cattle were in evidence at the time of my visit. It is very difficult, for a newcomer at least, to tell just which species are weeds and which are natives, so that the number of parentheses in the following list should not be taken too literally.

* For topographic maps of parts of the coast prairie in Harris County, on a scale of two inches to the mile, with one-foot contour intervals, see the Cypress, Addicks and Aldine quadrangles of the U. S. Geological Survey, published in 1918 and 1919. The narrow wooded areas along streams are indicated by green overprint.

The cause of the prairie mounds is still a mystery (see Plant World 17: 39, 41. 1914), but the domes are geological structures, which usually indicate accumulations of salt or petroleum, or both. The most noted dome in the whole country is Spindletop, a few miles south of Beaumont. Oil derricks are abundant there and in numerous other places scattered over the prairie coast.

† The type specimen of *S. Riddellii* Van Eseltine (Contr. U. S. Nat. Herb. 20: 162–163. Nov. 1918) is from Prairie View, Waller County.

‡ See Science II. 48: 208–211. Aug. 30, 1918. At Port Arthur, in the southeastern corner of the state, every house has a galvanized iron cistern to catch water from the roof, indicating copious summer rain and—presumably—unpalatable ground-water.

One might suppose that such a large and interesting and easily accessible prairie area would long ago have attracted both taxonomists and ecologists in considerable numbers, and that several descriptions of it would have been published before this: but the information about it in the existing botanical literature is so meager* as to be of very little assistance in identifying the plants that were not in bloom the latter part of August. Consequently the subjoined list contains many interrogation points, and even the names not queried should not be accepted without reservations; but this is at least superior to previous lists for the same region in being longer and having the species arranged in approximate order of abundance.

The composition of the prairie vegetation varies considerably from place to place, even where soil conditions appear to be the same, and—which cannot be said of the three regions last described—many of the species are unknown east of the Mississippi River. This, together with the lack of flowers in many cases (which made even generic identifications doubtful sometimes), made it impossible for me to get a thoroughly representative list of plants in the short time available.

Trees in the coast prairie are chiefly hardwoods characteristic of the neighboring hammock belt, growing on the banks of permanent or intermittent streams, small groves of *Pinus Taeda* near the inland edge, and a species of *Crataegus* near the Brazos alluvial region to be described next. The only native shrubs observed were *Myrica pumila*, which is common on mounds and in other dry places, and *Borrichia frutescens*, in damp spots toward the coast.† If the exotic *Daubentonia longifolia* is classed as a shrub (and it is certainly much larger than the two native shrubs just mentioned, though probably shorter-lived), it is the most abundant one at the present time, in all sorts of places. *Rosa bracteata*, an Asiatic species, is scattered around Rosharon, in Brazoria County.

* A few of the characteristic genera, both native and introduced, are mentioned on pages 19–20 of Bailey's Biological Survey of Texas; and Bray, on page 86 of his Bulletin 82, lists 22 species and 4 additional genera from the coast prairie, apparently mostly spring-flowering.

† Shrubs not provided with subterranean stems, as *Myrica pumila* is, would lead a very precarious existence on a prairie subject to fire.

The following herbs were noted in going from Beaumont to Port Arthur and back (three or four miles of it on foot) on August

FIG. 4. Prairie vegetation south of Nederland, Jefferson County. *Euphorbia marginata* and *Eupatorium serotinum* in foreground. August 21.

22, from Prairie View to Houston on the 25th, and from Houston to Columbia and Brazoria to Houston on the 26th.

(*Euphorbia marginata*)	*Paspalum* sp.
(*Croton capitatus*)	*Ambrosia psilostachya*
Euphorbia hexagona?	*Spartina patens?*
Gaura Lindheimeri	*Lythrum lanceolatum?*
Mesadenia lanceolata	*Neptunia lutea?*
Chamaecrista fasciculata	*Euthamia lanceolata?*
Helianthus sp.?*	*Baptisia sphaerocarpa?*
Baptisia leucophaea	*Jussiaea grandiflora*
(*Helenium tenuifolium*)	*Mimosa strigillosa?*
(*Glottidium vesicarium*)	*Sarothra Drummondii*
Eryngium yuccifolium	(*Euphorbia maculata*)
Eupatorium serotinum	*Spilanthes repens*
Boltonia diffusa	*Cuscuta arvensis*
Chaetochloa sp.	*Spartina junciformis?*
Diodia virginiana	*Eryngium Leavenworthii?*
(*Capriola Dactylon*)	*Nama corymbosum*
Centella repanda	*Lippia* sp.

(and about 40 others less abundant)

*A small erect composite with roughish linear leaves, not in bloom at this time, so that the genus is uncertain.

No doubt observations made along other routes, at other seasons, and after more experience in this part of the country would greatly extend this list and change the sequence considerably. But it is probably safe to say at this time that the families most largely represented are Compositae, Leguminosae, Euphorbiaceae and Gramineae (using these names in the older and broader sense), and that the total number of native species that could be found is well over 100. The general aspect of the vegetation is much like that of some Illinois prairies, but the flora is of course very different, on account of the difference in climate. There is naturally a little more resemblance to the Grand Prairie of Arkansas.*

A few of the economic features of this region may be of interest, besides the area of farm land which has already been given. In 1910 the foreign white farmers (19 per cent of the total) outnumbered the negro farmers (15 per cent). The average white farmer had 205 acres of land, of which 71 were improved, including 2.7 acres of cotton and 7.9 of corn; and his buildings were worth $842. The yield of corn was 22.2 bushels per acre, which is higher than in any of the regions previously described, and seems to indicate that prairie soils are best for corn. (The black prairie ranked next in this respect.)

The average negro farmer had 70 acres with 28 improved, of which 3.3 were in cotton and 5.7 in corn. His buildings were worth $256 (a little more than in the black prairie), and his corn crop was 16.4 bushels per acre.

The Brazos alluvial region.—All the streams traversing the coast prairie seem to be bordered by strips of woodland, but along the Brazos and one or two near-by rivers near their mouths the wooded area is large enough to be treated as a separate region, as shown on the map. Its boundaries are pretty well defined, on the east at least, and it is said to cover about 900 square miles, mostly in Brazoria County. It has been described by Loughridge in his report on the cotton production of Texas,† and by Wm. T. Carter, Jr., in a "Reconnoissance soil survey of the central Gulf coast area of Texas."‡ The latter covers all of this region except the

* See Plant World **17**: 40–44. 1914; **20**: 58–61. 1917.

† Tenth Census U. S. **5**: 702–704. 1884. This includes two soil analyses.

‡ Field Operations U. S. Bur. Soils **1910**: 859–929. *pl. 1–8.*

small portion in Fort Bend County, as well as several counties occupied chiefly by coast prairie.

This is not exactly a delta, as one might imagine from the map, nor even a flood-plain, for it is not noticeably lower than the adjacent country, and it does not appear to be subject to frequent inundation. At Columbia, about 25 miles from the coast, both banks of the river are something like 30 feet high and rather steep, which is quite a different condition from that along most rivers from New Jersey to Florida at that distance from their mouths, where the banks are usually low and swampy. (The Brazos differs also from most rivers of its size farther east in the coastal plain in having practically no navigation. Although it is about a thousand miles long and is said to have a drainage area of over 40,000 square miles, the highway bridge at Columbia, though equipped with a draw span, had that permanently closed at the time of my visit so that it could not be turned to allow steamers to pass.)

The soil varies with the distance from the river and coast, but much of that which I walked over between Columbia and Brazoria is a chocolate-colored stiff clay, designated on the government soil map just cited as "Trinity clay." A few of the characteristic trees were listed by Loughridge, and Carter described briefly the vegetation of nearly every type of soil in the whole area mapped by him, except—curiously enough—the "Trinity clay," which covers the greater part of the alluvial region. Both Loughridge and Carter make special mention of the "wild peach," *Prunus caroliniana*, and Carter states that it is the most characteristic tree of one of the less extensive types of soil, the "Pledger silt loam," the boundaries of which may be traced by its presence. But strange to say, I did not happen to see any of it, or of *Juniperus virginiana*, which according to Professor Bray* was formerly abundant in this region, at least near the mouth of the San Bernard River.

My observations in this rather unique area were all made on August 26, from the train, for about ten miles before arriving at Columbia, and in walking down the west side of the river, probably nowhere more than a mile from it, to Brazoria, and then from another train from Brazoria a few miles northeastward to the edge of the prairie again. The commonest plants seem to be as follows:

* U. S. Forestry Bull. 47: 54. 1904; Univ. Texas Bull. 92: 68. 1907.

LARGE TREES

Hicoria Pecan — *Acer Negundo*
Quercus virginiana — *Gleditsia triacanthos*
Ulmus crassifolia — *Quercus* **nigra**
Celtis sp.

SMALL TREES

Crataegus sp. — *Salix nigra?*

SHRUBS AND VINES

Ilex vomitoria — *Rhus radicans*
Ampelopsis arborea — *Tecoma radicans*
Sabal glabra — *Ilex decidua*
Vitis cinerea — *Berchemia scandens*

HERBS

Tillandsia usneoides — (*Atheropogon curtipendulus*)
(*Daubentonia longifolia*) — (*Helenium tenuifolium*)
(*Cardiospermum Halicacabum*) — (*Croton capitatus*)
(*Euphorbia marginata*)

The abundance of trees and shrubs with small thick or evergreen leaves—such as *Quercus virginiana*, *Ulmus crassifolia*, *Ilex vomitoria*, and the two trees mentioned in a preceding paragraph—and the absence of *Liquidambar*, in such a rich-looking

FIG. 5. *Ilex vomitoria*, *Hicoria Pecan*, *Sabal glabra*, etc., on dark brown stiff clay in Brazos River bottoms between Columbia and Brazoria. August 26.

soil, is rather surprising. It is also interesting to note that there are more vines than shrubs in the list, and that all the herbs but the first-named (and that is an epiphyte) are weeds. The scarcity of native herbs in a list made up from car-window notes in a densely wooded region would not be surprising, but in this case I was on the ground for a few hours, and walked eight or ten miles. Several other herbs were seen only once or twice and therefore not listed above, but practically all of those were weeds too.

The economic features of this region deserve a passing mention. It covers about half of Brazoria County, and the census statistics for that county therefore give an approximation of conditions in the alluvial region. Less than 10 per cent of the area of the county was cultivated in 1910, and there were nearly as many negro as white farmers. (Negroes are probably in the majority in the alluvial region.) The average white farmer in the county had 240 acres, of which 57 were improved, and buildings worth $917; while the negro farmer got along with 41 acres, 25 of them improved, and buildings worth $165. The large size of the white men's farms and the value of the buildings on them (surpassing any other region in eastern Texas in both respects) probably indicate that many if not most of them were sugar plantations. For according to Loughridge this region was called the "sugar-bowl" of Texas, on account of being the chief sugar-producing area of the state.* The average white farmer in the county had only about 2 acres in cotton and 8 in corn, while his negro neighbor had nearly 7 acres in cotton and 8½ in corn. The yield of cotton in 1909 was very low, only about a tenth of a bale per acre.

CONCLUSION

A week's sojourn in eastern Texas, supplemented by examination of the literature afterward, brought out some very pronounced contrasts between different portions, and considerable difference between the area as a whole and other parts of the coastal plain in the same latitude several hundred miles farther east, say in Alabama and Georgia, where temperature conditions are substantially the same and the annual precipitation not much greater.

* In 1880 the only Texas counties that had more than 300 acres of sugar-cane were Brazoria, with 3358, and Fort Bend, with 1738. In 1910 Fort Bend had 6775 acres, Wharton 4714, and Brazoria 2037. (These three counties are all contiguous.)

Considering physical features first, Texas evidently has more black soil and less sand and red soil, less potable water, water-power and navigation, and fewer gullies, steep hills, rich woods, ravines, caves, springs, clear streams, non-alluvial swamps, and bogs than the more easterly states.

Botanically eastern Texas, comparatively speaking, seems to be poorly provided with shade-loving spring flowers, *Sphagnum*, ferns, *Juniperus*, *Taxodium*, orchids, *Arundinaria*, Cyperaceae, *Populus*, *Betula*, *Alnus*, *Fagus*, *Quercus alba*, *Magnolia glauca*, *Liriodendron*, *Platanus*, *Acer rubrum*, *A. saccharinum*, *Sassafras*, *Cornus*, *Nyssa*, Ericaceae and *Sambucus*, to mention a few of the more obvious cases. If we had more complete information about the composition of Texas soils we could probably explain some of these things better than we can now.

INDEX TO AMERICAN BOTANICAL LITERATURE

1915-1920

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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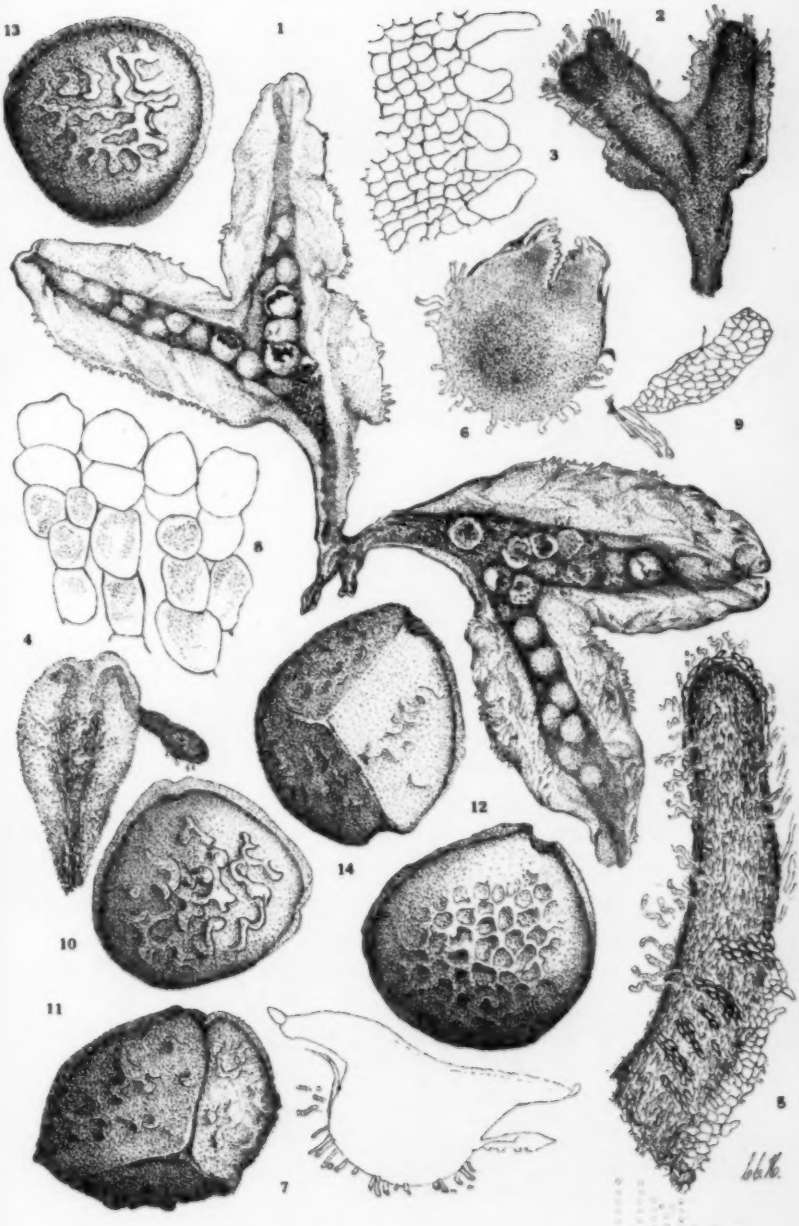
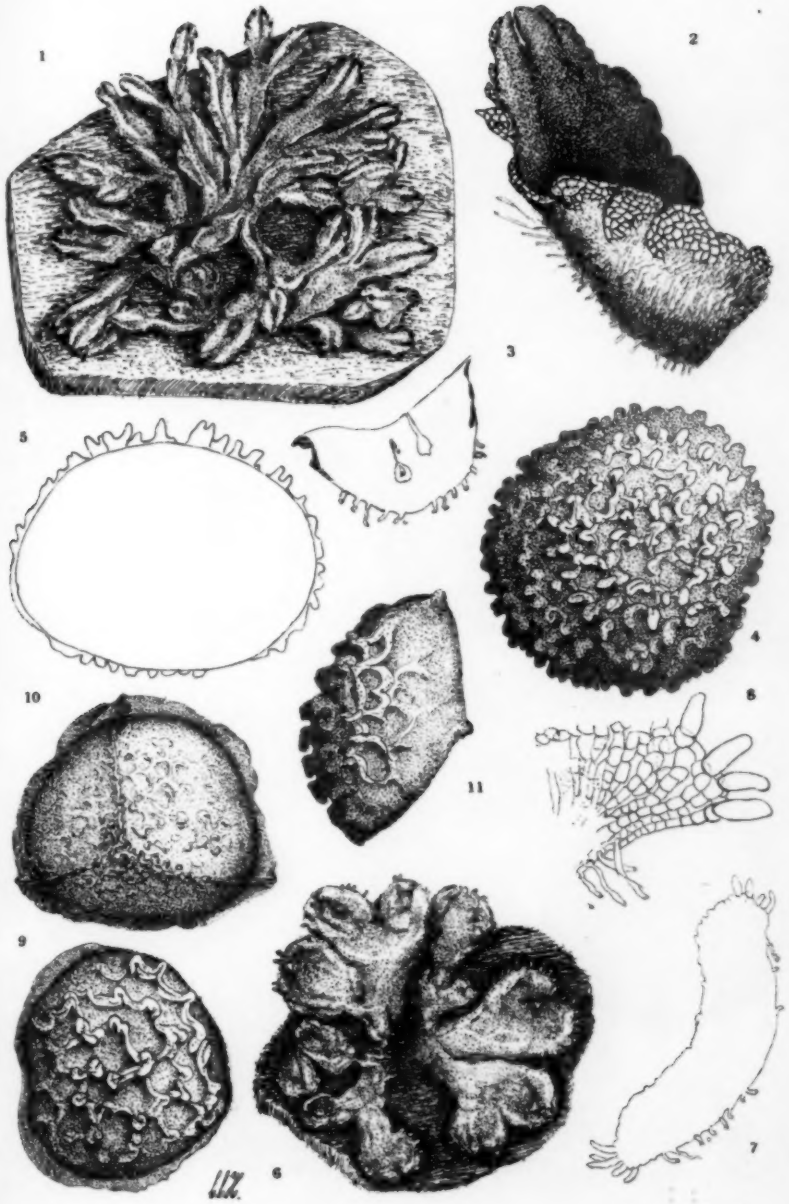


RICCIA DONNELLII AUST.

HELIOTYPE CO., BOSTON



1-5. RICCIA DICTYOSPORA M. A. HOWE
6-11. RICCIA BEYRICHIANA HAMPE

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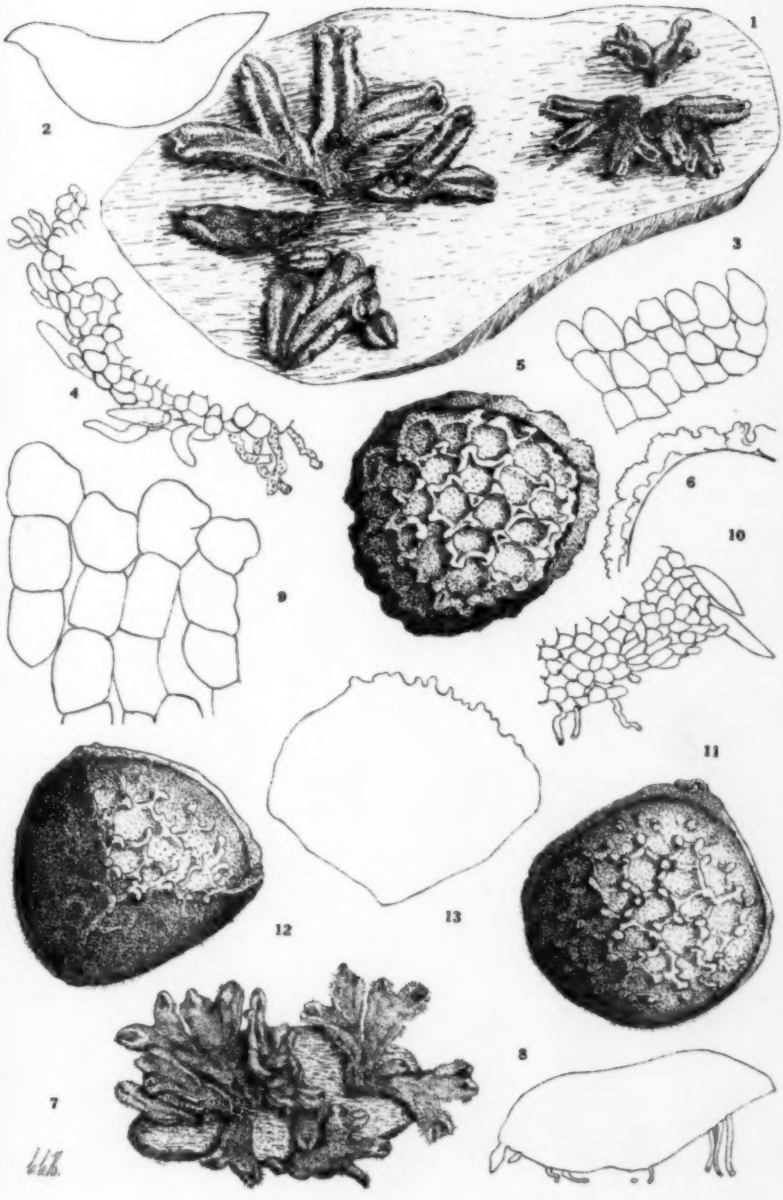
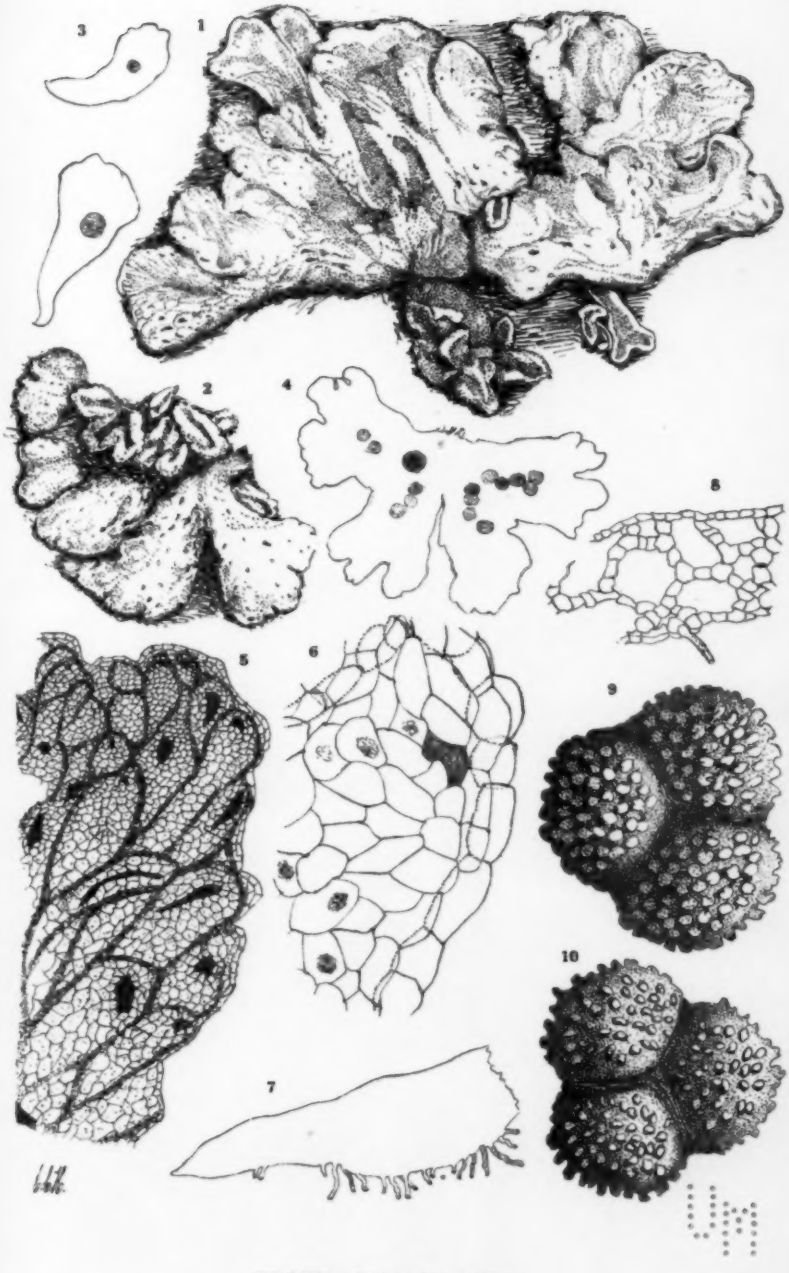


1-6. RICCIA ARVENSIS AUST.
7-13 RICCIA HIRTA AUST.

HELIOTYPE CO. BOSTON



RICCIA CURTISII JAMES

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